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Safe learning and assessment for anaesthetic apparatus checks

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This article discusses the safe learning and assessment for a component of the anaesthetic apparatus check. It reports on an innovation to facilitate a realistic medical gas pressure check. For clarity, the term 'anaesthetic practitioner' (Wicker & Smith 2006) is used to refer to operating department practitioners and perioperative nurses who work as members of the anaesthetic team, as opposed to 'anaesthesia practitioner' (Wilkinson 2007) which refers to non-medical anaesthetists.

Introduction

The surgical patient is vulnerable to serious injury during the perioperative phase. Incidents involving medical gas supply leading to serious injury and death have been given a high profile in the popular media (BBC 2001, Jackson 2001, Institute for Safe Medication Practices 2004, BBC 2006). Perioperative practitioners such as operating department practitioners (ODPs) and anaesthetic nurses are required to prepare complex patient care equipment as a part of their daily routine. Effective professional development for safe practice is therefore imperative. Jane Reid has summarised this point to great effect: '*Education for practice is an essential element of professional development, synonymous with the concepts of quality, standards of care and professional accountability*' (Reid 2000, p64).

This article will address specific professional and educational requirements for nurses and ODPs acting as the anaesthetic practitioner. It will describe issues of competency-based development for professionals who provide direct patient care. A description is given for the use of a modified air compressor, employed to facilitate a realistic checking scenario. With this innovation learners are able to develop competence in preparing anaesthetic apparatus in a safe location without compromising patient safety. The assessment process, which utilises this equipment, is analysed. Finally, the assessment of learners performing anaesthetic apparatus checks is linked to practice.

Safe apparatus checks

In 2001 the investigation into the death of a nine year-old boy during a general anaesthetic for elective surgery resulted in 20 recommendations of best practice guidance. The report, entitled *Protecting the Breathing Circuit in Anaesthesia* (DH 2004), appraised the work of the National Patient Safety Agency in analysing three categories of anaesthetic incidents reported between 1956 and 2002. These categories addressed:

- occlusions in anaesthetic breathing circuits and attachments
- anaesthetic machines and apparatus
- malicious or reckless conduct and rule violation.

AAGBI recommendations

The guidance document recommends ways of checking of anaesthetic apparatus and the training of those who prepare anaesthetic equipment. Reference is given to specific responsibilities of ODPs and anaesthetic nurses and the importance of consistently applying Association of Anaesthetists of Great Britain and Ireland (AAGBI) guidance for the checking of anaesthetic equipment. It recommends delegation of parts of the checking procedure among anaesthetic team members (to include anaesthetists, ODPs and anaesthetic nurses). Delegation of tasks must be made explicit and confirmation that the activity has been completed should be recorded. The revised AAGBI guidance, to which this report refers, provides a detailed account of essential apparatus and relates the tasks to the educational concept of competency-based training (AAGBI 2004). Wicker and Smith (2006) analyse the duty of care and professional responsibilities in relation to pre-session apparatus checks. They conclude that practitioners, employing institutions and governing bodies utilise the AAGBI checklist as a tool for risk reduction and prevention of litigation.

The Schrader connection

The AAGBI guidelines recommend that a pre-session check of medical gas pipeline connections be made. The Schrader connection consists of a socket and a probe and is designed to provide a safe junction between the anaesthetic machine and the central supply of medical gas, such as a manifold or an oxygen concentrator (Al Shaikh & Stacey 2005). A key safety feature of this item is an indexed non-interchangeable socket to which the probe connects (Davey & Diba

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2005). The purpose of the Schrader connector is to reduce the risk of accidental connection to the supply of a different gas (Anaesthesia UK 2005). The gas supplies are usually oxygen, nitrous oxide and medical air. The pre-session checking process is the responsibility of the anaesthetic team.

Medical gas pipeline pressure

The purpose of the pre-session check of medical gas pipelines is to confirm that each Schrader connection is secure and delivers the medical gas pipeline service. Observing a pressure gauge, integral to the anaesthetic machine, provides confirmation. The pressure at which medical gases are delivered by pipeline systems is generally 400 kPa (4 Bar) and the person performing the pre-session check must confirm this upon connection of the Schrader probe and socket. The AAGBI (2004) guidance recommends that where Schrader probes remain connected, prior to an anaesthetic apparatus check, a '*tug test*' be performed. This is to confirm correct insertion of each pipeline rather than performing a full disconnection and reconnection manoeuvre. The rationale being that excessive wear on the probe and socket could potentially lead to early failure of the device (AAGBI 2004). Some anaesthetic machines require a disconnection, however, because the oxygen failure alarm can only be tested in this way.

Valid and reliable assessment

Wicker and Smith (2006) provide a comprehensive discussion related to the safe and competent preparation of anaesthetic apparatus. They promote an understanding of the anaesthetic practitioner's duty of care to reduce the potential for serious untoward incidents. The checking of anaesthetic apparatus is an established component of pre-qualifying programmes of study. For example, the standards of proficiency for ODPs require an understanding of the principles underpinning safe use of anaesthetic equipment (HPC 2004). Various sources of evidence have influenced the development of nursing and allied healthcare curricula since 2000 in ways that prioritise skills development (DH 1999, UKCC 1999).

Educational theory informs professional standards of proficiency and the assessment of practice. The psychomotor domain is one of three domains of learning in established educational theory (Fry et al 2003, Reece & Walker 2003). Psychomotor learning involves measuring manual skills: it refers to the manipulation of equipment, tools or objects. There are three stages associated with this learning domain: **purpose**, **procedure** and **practice** (Reece & Walker 2003). The **purpose** is defined as the aim or objective: assessment criteria, for example. The **procedure** refers to rules or guidance, for example, the AAGBI checklist. The **practice** is the performance, such as the act of connecting a Schrader probe and socket.

Approved assessment methods

Learners enrolled on current healthcare programmes are required to undertake competency-based assessment to confirm safe and systematic demonstration of clinical skills. Assessment methods are subject to approval from professional bodies and are expected to meet educational standards (HPC 2006, HPC 2007). One assessment method that is used frequently in healthcare programmes is the Objective Structured Clinical Examination (OSCE) (Fry et al 2003). The OSCE consists of simulated practice activities (for example, taking a pulse measurement). OSCEs should be criterion-referenced to ensure reliability. This is to ensure that if a learner being assessed were to repeat the process, the same results would occur with a different assessor. Criteria for pulse measurement might include:

- check for recent exercise
- locate radial pulse accurately
- using watch with second hand, count for 30 seconds (if regular) and record rate
- using watch with second hand, count for 60 seconds (if irregular) and record rate
- patient's pulse:..... student's reading:.....
- recognise if the reading is accurate and within normal physiological range
- records rate accurately on patient documentation.

This example of OSCE assessment criteria possesses validity (it assesses what it claims to assess) and reliability (different assessors would make the same judgement of competency). The concepts of validity and reliability require more detailed definition and analysis.

Validity

A systematic review by Rushforth (2006) has identified that OSCEs are motivating and are viewed positively by both learners and assessors. Therefore, this educational process commands engagement from those involved. However, Rushforth (2006) also highlights some disagreement in the literature concerning issues of validity. Her review identifies debate concerning criterion validity (the statements by which the learner is assessed). For example, the statements related to reading a pulse (given above) might be criticised for failing to differentiate the quality of the learner's actions. Therefore, when designing OSCE criteria, care should be taken to discuss the validity of the test with a range of experts.

Reliability

Alinier et al (2004) confirm that OSCEs can be a reliable indicator of competence to support the development of clinical skills. When analysing reliability a well-designed OSCE with clearly defined

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Figure 1 Bambi VT75 air compressor mounted on a utility trolley

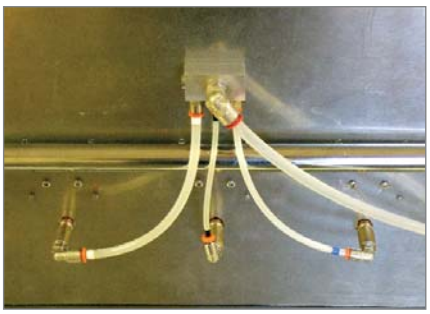

Figure 2 Showing the distribution of pressurised air to three Schrader sockets

Figure 3 Anaesthetic machine pipeline probes connected to sockets

marking criteria supports inter-rater reliability. Inter-rater reliability is concerned with consistent agreement between different assessors (Reece & Walker 2003). A video recording of the learner undertaking an OSCE would allow comparison by various experts in order to achieve consensus.

Education for practice

McCallum (2006) provides evidence from a systematic literature review that supports the use of simulation to perform procedures that remove risk to patients. She suggests that criterion-referenced learning and assessment strategies are robust and can be a valid measurement of fitness for practice. It may be beneficial for these assessment events to take place in a Higher Education Institution (HEI) initially, so that the burden of assessment in the clinical area is reduced (Alinier et al 2004, McCallum 2006). Preparation of learners' skills before embarking on a process of development in the clinical area enhances safe learning at the patient bedside. Howie (2004) has emphasised the necessity for competency testing that is related directly to the activities performed as part of the role of anaesthetic practitioner.

An innovative approach for safe skills development

The recent introduction of a modified air compressor in an HEI has been implemented to deliver regulated, pressurised atmospheric air to Schrader sockets. This enhances the skills development of anaesthetic practitioners learning to check anaesthetic apparatus. A Bambi VT75 oil free air compressor has been used (Bambi Air Compressors 2006), a product made specifically for dental and healthcare services. The compressor is mounted on a utility trolley and a panel containing three Schrader sockets has been attached to the top of the trolley (Figure 1). The sockets are indexed non-interchangeable collars for oxygen, medical air and nitrous oxide. A three-way connector has been introduced to provide pressurised atmospheric air to each of the Schrader sockets (Figure 2). Two of the trolley wheels are fitted with brakes to facilitate demonstration of the pipeline tug test.

A realistic connection of the Schrader probe and socket can now be performed for oxygen, medical air and nitrous oxide in the HEI skills facility (Figure 3). The pipeline pressure can be pre-set at 400 kPa to facilitate measurement on the anaesthetic machine pressure gauges. Alternatively the pressure can be adjusted up or down, in order to assess accurate reading of gauges and understanding of acceptable ranges of pressure by the learner. Nitrous oxide is subject to occupational exposure limits set by the Health and Safety Executive (Aitkenhead et al 2007). Because the pressure is delivered by compressed air the learners are not exposed to environmentally hazardous substances such as nitrous oxide when checking the flowmeters and vaporizers. Occupational exposure limits are therefore no longer a risk during this learning experience.

Implementation of assessment for anaesthetic apparatus check

A Diploma in Higher Education award in Operating Department Practice delivered at Oxford Brookes University assesses competence for checking anaesthetic apparatus with an OSCE. This method of criterion-referenced assessment facilitates the safe development of skills: in this case the AAGBI guidelines form the assessment criteria of the OSCE. Fifty first year student ODPs undertake the OSCE in the eleventh week of their clinical practice experience.

The following statements are drawn from the OSCE assessment criteria,

The learner is able to develop in an environment that is safe and they can make mistakes without compromising patient safety

established in 2004, and based upon the AAGBI checklist for anaesthetic equipment:

- Identify the pipeline gas connections.
- Explain the issues related to performing a 'tug test' on each pipeline.
- Discuss pressure gauges and state appropriate pressures for gas supply.

The statements support the demonstration of competent pipeline appraisal during a full check of anaesthetic machine, airway adjuncts and intubation equipment. Each learner is assessed on their knowledge of Schrader connections, '*tug test*' and pressure gauges.

The OSCE takes place in the skills lab of an HEI rather than an operating department – an environment that does not compromise patient safety should the learner make a mistake. The absence of pipeline gas supplies in this environment makes it necessary for the learner to explain and discuss the use of a Schrader socket, the '*tug test*' and the pipeline pressure check. It has not been possible for learners to demonstrate connection of the Schrader probe and socket, perform '*tug tests*' or read an activated pressure gauge. The lack of opportunity to demonstrate a pipeline check, as recommended by the AAGBI guidance document, undermines the validity of the assessment since it does not measure the acquisition of psychomotor skills. Furthermore, there is a chance that different assessors would draw different conclusions about learner explanation or discussion. Consequently the reliability of the OSCE could be challenged.

Improved assessment

The compressor has enhanced the realism and the validity of the OSCE. Learners now address their needs as a novice checker of anaesthetic apparatus in a safe environment and their competence can be formally assessed. The modified compressor has improved fidelity and safety for medical gas supply checks during the OSCE. Modified assessment criteria have been introduced to take account of enhanced fidelity. Rather than identify, explain and discuss, the learners undergoing assessment now address improved criteria. They are required to:

- state the purpose of a medical gas pipeline check
- correctly identify and connect the pipeline gas connections
- measure pressures for gas supply using the Bourdon pressure gauges
- perform a '*tug test*'.

The student ODPs and other anaesthetic practitioners who learn skills in this environment are now able to address valid and reliable assessment criteria.

Conclusion

The modified compressor has been assembled to facilitate the development of specific skills. Skills that have an impact on the well-being of patients undergoing high-risk procedures in an acute care environment. The learner is able to develop in an environment that is safe and they can make mistakes without compromising patient safety. Anaesthetic practitioners can be accurately assessed on their competence to perform the pre-session check in a safe location, prior to performing it in a clinical environment on equipment that will be used for anaesthetising patients. The learners are not exposed to nitrous oxide while developing the ability to check anaesthetic apparatus.

This innovation has been devised to support the safe development of perioperative skills that conform to NPSA and AAGBI guidance with the aim of reducing injury to patients. It supports the development of safe standards of care and prepares learners for practice and professional accountability.

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